




BOSE[®]






RoomMatch™

Array Design and Installation Manual
Installation and Safety Guidelines
(For professional installation and use only.)

-  **This product is intended for installation by professional installers only!** This document is intended to provide professional installers with basic installation and safety guidelines for Bose RoomMatch™ loudspeakers in typical fixed-installation systems. Please read this document before attempting installation.
-  **WARNING:** All Bose® products must be used in accordance with local, state, federal and industry regulations. It is the installer's responsibility to ensure installation of the loudspeakers and mounting system is performed in accordance with all applicable codes, including local building codes and regulations. Consult the local authority having jurisdiction before installing this product.
-  **WARNING:** Unsafe mounting or overhead suspension of any heavy load can result in serious injury and equipment damage. It is the responsibility of the installer to evaluate the reliability of any mounting method used for their application. Only professional installers with the knowledge of proper hardware and safe mounting techniques should attempt to install any loudspeaker overhead.

Guidelines for Permanent Installation of RoomMatch™ Array Module Loudspeakers

The installation information contained in this document is only a general guideline and cannot, as such, represent all requirements and precautions. Accordingly, anyone using this material assumes all liability and is expressly responsible for the safety of all loudspeaker array designs and mounting configurations applied in practice.

- 1) Prior to the installation of any overhead loudspeaker, a licensed professional engineer must approve the location and method of attachment to the building structure and confirm they are consistent with all building codes and regulations. Ensure the mounting surface and the method of attaching the loudspeaker system to the surface is capable of supporting the total weight of the system. A safety factor of 10:1 is recommended.
 - 2) Obtain all mounting system components from reputable manufacturers. Select a mounting system appropriate for your loudspeaker system and its intended application. We recommend Bose mounting accessories when available. A licensed professional engineer must review the design and fabrication of any custom mounting hardware.
 - 3) Bose RoomMatch™ array module loudspeakers feature an integrated side-plate rigging system, designed to facilitate loudspeaker array mounting by professional installers. Module to module connections should be made using only the integrated rigging side plates with the included M10 graded fasteners. Do NOT use SAE 3/8" size threaded hardware! Use only metric hardware. Fasteners should be metric Class 10.9 (load bearing rated) or equivalent. Unmarked (not rated for load bearing) fasteners should not be used.
 - 4) Do not suspend loudspeaker using handles as attachment points. **Handles are NOT designed for load bearing!**
 - 5) Use lock washers or a locking compound intended for hand disassembly, such as LOCTITE® THREADLOCKER BLUE 242® compound, for a vibration resistant assembly.
 - 6) Fasteners should be tightened using torque of 35 to 40 foot-pounds (47 to 54 Newton-meters). Over-tightening the fasteners could result in irreparable damage to the cabinet and create an unsafe assembly.
 - 7) Do not attempt to alter the threaded attachment points or re-thread the attachment points to accommodate any other thread size or type; doing so will compromise the safety while permanently damaging the loudspeaker.
 - 8) Use a safety cable, separately attached to the cabinet, at a point not in common with the load bearing attachment points of the mounting system to the loudspeaker. This is recommended even if not required by local regulation. Consult a licensed professional engineer or a rigging professional for proper design and installation.
-  **CAUTION:** Installed loudspeaker arrays require regular inspection and routine maintenance to ensure proper function and safe operation. Inspect mounting hardware and attachments for signs of corrosion, bending or any other condition that may decrease the structural integrity. Immediately replace worn or damaged components.
-  **CAUTION:** Make no modifications to the loudspeakers or mounting accessories. Unauthorized alterations may compromise safety and could result in damage, injury, or death.
-  **CAUTION:** Never exceed 8 RoomMatch modules using the integrated rigging side plates for arrays. Please refer to product labels and the Array Design and Installation Guide document for Working Load Limit data.

Introduction

This document is intended to provide professional installers of sound reinforcement equipment basic guidelines for the design and assembly of Bose RoomMatch™ loudspeaker arrays. The document will list the Working Load Limits of each component and provide general guidelines for determining the acceptable working loads for the entire array. In general, information that is available in other documents for RoomMatch components is not duplicated in this document. Please see pro.Bose.com to download these files.

Component Description – Loudspeaker Modules

Each RoomMatch module is a 2-way, full-range loudspeaker designed to form progressive directivity arrays for fixed-installation sound reinforcement of the highest-quality live music and speech. Overcoming the limitations of both line array and point-source conventional designs, RoomMatch modules define a new category of loudspeaker by delivering unprecedented sound quality for a wide variety of room sizes and shapes, acoustic requirements, and budgets. System flexibility provides precise, constant-directivity coverage, from single modules up to 8-module arrays, to ensure consistent tonal balance for many different room shapes and acoustic requirements.

The full-range modules are shipped with integrated side-plate array rigging hardware. The rigging system is designed to allow fast construction of typical fixed-installation arrays of up to 8 modules, while maintaining a 10:1 Safety Factor.

A companion subwoofer, the RoomMatch RMS215 module is also available for systems that require additional low-frequency level and impact. The RMS215 module is designed to integrate with RoomMatch™ arrays using the optional side-plate mounting kit for suspended applications. The side plates are not required for floor-mounted installations.

Figure 1. RoomMatch™ RMS215 subwoofer module

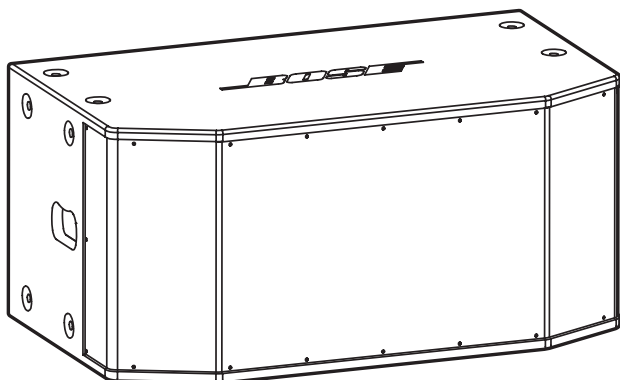


Figure 2. RoomMatch™ RM7020 module

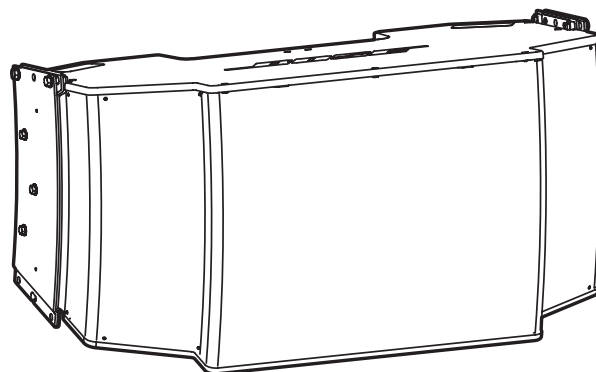


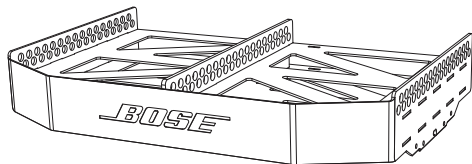
Figure 3. RoomMatch™ Module Dimensions and Weights

Dimensions and Weights										
Array Module	Coverage		Dimensions						Net Weight	
			Inches			mm				
	H°	V°	Height	Width	Depth	Height	Width	Depth	lb	kg
RMxx05	Any	5	16.9	39.1	23.6	428	993	598	123	55.8
RMxx10	Any	10	17.9	39.1	23.6	455	993	598	123	55.8
RMxx20	Any	20	20.0	39.1	23.6	509	993	598	123	55.8
RMxx40	Any	40	24.0	39.1	23.6	610	993	598	124	56.3
RMxx60	Any	60	27.5	39.1	23.6	700	993	598	125	56.7
RMS215*	Omni	Omni	17.8	37.1	21.8	452	943	553	132	59.9

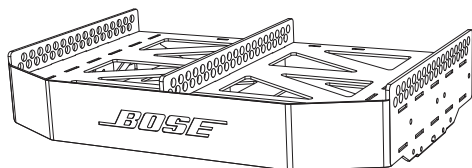
*Dimensions and weight of RMS215 do not include RMSFLY rigging kit.

Component Description – Rigging Hardware and Accessories

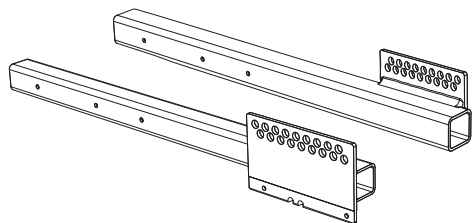
RoomMatch™ Array Frame rigging accessories are designed for fixed-installation overhead suspension of RoomMatch full-range and subwoofer array modules. Use with non-RoomMatch loudspeakers is not recommended.



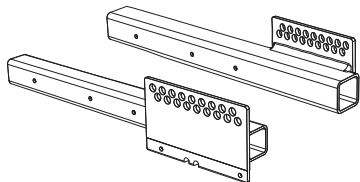
RMAFSM Small Array Frame. Use with 1 to 4 full-range or subwoofer modules in overhead suspended arrays.



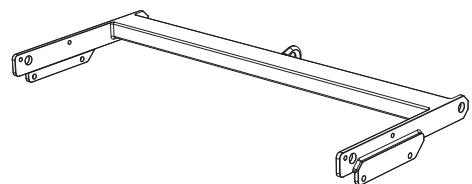
RMAFLG Large Array Frame. Use with 4 to 8 full-range or subwoofer modules in overhead suspended arrays. Compatible with Long and Short Extender Bars (see below). When used with Extender Bars, the Large Frame will support up to 8 modules, with an additional 2 subwoofer modules mounted behind the primary array. This is the largest array possible and typically requires the RMPULL bracket for 3-point suspension for most array pitch angles.



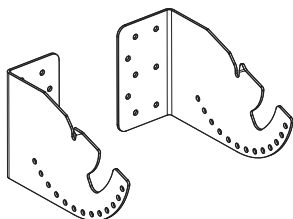
RMXLNG Long Extender Bars. Use with Large Array Frame to accommodate up to 2 subwoofer modules mounting in back of primary array. Also provides additional shackle mounting holes to allow more extreme angles for 2-point mounting. Kit of left and right pair with fasteners.



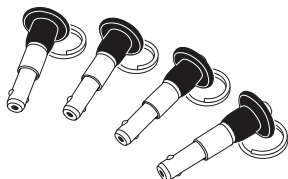
RMXSRT Short Extender Bars. Use with Large Array Frame to accommodate up to 2 subwoofer modules mounting in back of primary array. Also provides additional shackle mounting holes to allow more extreme angles for 2-point mounting. Kit of left and right pair with fasteners.



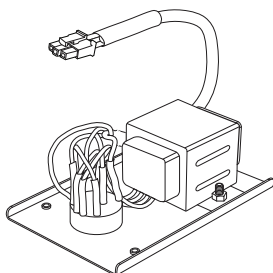
RMPULL Pull Back Bracket. Use with bottom-most array module to provide third-point suspension to building structure to allow more extreme downward angle of arrays than possible from 2-point, gravity-hang suspension. The RMPULL bracket can also be used as a “mini frame” for suspending 1 or 2 modules. Single bracket with fasteners.



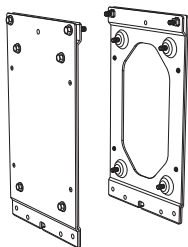
RMBRKT Surface-Mount Bracket. Allows a single full-range module to be mounted on flat surfaces, such as building walls or ceilings. The brackets allow pitch angle adjustment from 0° up to -90°, depending on module. Brackets attach to the side-plate rigging hardware of each full-range module. (RMBRKT bracket is NOT intended for use with RoomMatch subwoofer modules.) Kit of left and right pair with fasteners.



RMPINS Quick Release Pins Kit. Set of 4 Quick-Release Pins designed to replace the graded M10 fasteners for module-to-module connections. May be used with RoomMatch™ full-range or subwoofer modules.



RMSHAD Module Gain Shading Kit. Optional accessory that installs in the input panel of RoomMatch full-range modules to allow attenuation of the bottom-3 compression drivers as compared to the top-3 drivers. This allows for more uniform sound pressure levels for specific module configurations and coverage areas.



RMSFLY is an accessory side-plate rigging kit for the RoomMatch RMS215 subwoofer module to allow integration of subwoofer modules in RoomMatch arrays. Kit of left and right pair with fasteners.

Additional accessories are available for ground stack arrays. Please refer to the document “RoomMatch Ground Stack Kit Accessories Installation and Safety Guidelines” for information regarding these accessories. The following table lists the dimensions and weights for RoomMatch accessories. For the RMBRKT, RMPINS, RMSFLY, RMXLNG, and RMXSRT parts, the dimensions are per piece. Weights listed are the total weights for all pieces included in the accessory kit:

Figure 4. RoomMatch™ Rigging Accessories Dimensions and Weights

Rigging Accessories Dimensions and Weights								
Part Name	Dimensions						Net Weight	
	Inches			mm			lb	kg
	Height	Width	Depth	Height	Width	Depth		
RMAFSM	5.7	38.0	27.8	146	966	655	122	55.3
RMAFLG	8.0	38.0	27.8	203	966	655	148	67.1
RMBRKT	8.7	5.3	5.1	222	134	129	15	6.8
RMPINS	0.9	0.9	2.2	22	22	56	1	0.5
RMPULL	3.1	38.1	16.8	80	967	426	26	11.8
RMSFLY	19.8	11.7	2.0	503	296	50	36	16.3
RMSHAD	3.1	4.8	1.7	78	123	42	2	0.9
RMXLNG	7.8	3.4	48.5	198	86	1231	88	40.0
RMXSRT	7.8	3.4	34.7	198	86	881	70	31.8

Designing RoomMatch™ Arrays

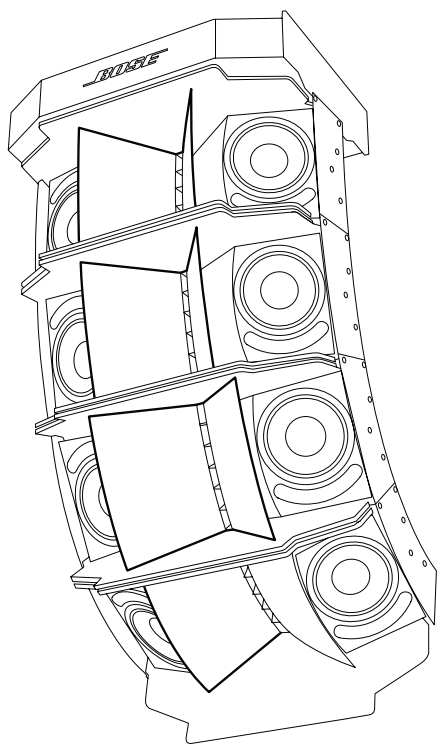
Appropriate Venues for RoomMatch Arrays

RoomMatch array module loudspeakers are designed to provide concert-quality sound for indoor, fixed-installation venues, such as performing arts centers, auditoriums, houses of worship, gymnasiums, and indoor sports areas. The flexible configuration of RoomMatch™ modules allows high-quality sound in these venue types, ranging from several hundred seats to more than 20,000 seats. However, RoomMatch is not recommended for outdoor installations or portable, touring-sound applications.

Introduction to Progressive Directivity Arrays

The proprietary technology of RoomMatch loudspeakers allows module configurations to form a new class of curvilinear array, that Bose has termed “progressive directivity array.” The key concept of the Progressive Directivity Array is the ability to vary both horizontal AND vertical coverage for each module in the array. For most venues, narrow patterns are used at the top of the array to cover rear listening areas, with coverage patterns getting progressively wider at the bottom of the array for the front listening areas. This flexibility allows the array coverage to be tailored to specific room dimensions and level requirements. Additionally, this approach uses the Directivity Index (DI) of modules to help equalize levels from front to back of the listening area, without using drastic attenuation of the lower modules.

Figure 5. RoomMatch™ Progressive Directivity Array (grills removed)



Array Parts List:

RMAFSM Small Array Frame

RM7010 array module (70°H x 10°V)

RM7010 array module (70°H x 10°V)

RM9020 array module (90°H x 20°V)

RM12040 array module (120°H x 40°V)

Array Configuration Types

RoomMatch rigging accessories allow for several basic types of module configurations: surface mount, full-range only array, full-range with subwoofer array, full-range with cardioid subwoofer array, subwoofer-only array. Each configuration requires different rigging hardware accessories. General guidelines for the accessories required for each of these categories is presented in the following section.

Surface-Mount. Mounting a single full-range module to a wall or ceiling surface requires use of the RMBRKT accessory. Suspension of a full-range module using wire rope (or other materials) attached directly to the module side plates is not recommended.

Full-Range Only. For arrays requiring only full-range modules, the RMPULL, RMAFSM, or RMAFLG accessories may be used, depending on number of array modules. The RMPULL bracket can accommodate 1 or 2 full-range modules (cannot be used with subwoofer modules). The RMAFSM and RMAFLG frames accommodate up to 4 and 8 modules respectively.

Full-Range with Subwoofer. For arrays requiring full-range and subwoofer modules, the RMAFSM frame may be used for arrays of up to 4 modules, while the RMAFLG frame can be used with arrays of up to 8 modules. The optional RMSFLY side-plate kit is required to mount the RMS215 subwoofer module in arrays. (The RMS215 module is shipped without side plates). The RMS215 subwoofer module should always be placed in the top positions, above any full-range modules.

Full-Range with Rear-Mounted Subwoofers. For arrays requiring full-range modules with subwoofer modules mounted behind the primary array (including cardioid subwoofer arrays), the RMXLNG or RMXSRT Extender Bars must be used with the RMAFLG Large Array Frame. The largest array possible with these standard rigging accessories is 8 modules in the front position suspended from the Large Array Frame and 2 additional subwoofer modules suspended from the Extension Bars in the rear position.

Subwoofer-Only Array. For arrays requiring only subwoofer modules, the RMAFSM frame may be used with up to 4 subwoofer modules, while the RMAFLG frame may be used with up to 8 subwoofer modules, in a vertical column with 0-degree pitch. When the RMAFLG frame is used with Extender Bars, the maximum allowable configuration is 2 subwoofers in the rear position, with 8 subwoofers in the front position, with an overall array pitch of 0 degrees. Note: the RMPULL bracket cannot be used to suspend subwoofer modules.

Examples of selected array configurations are shown in the Appendix section of this document.

Using Bose Modeler® Software for Array Design

RoomMatch array modules allow thousands of array configurations based on room dimensions, acoustics, and level requirements. Additionally the coverage pattern for lower frequencies varies with the number of modules in the array. Therefore, the use of Bose Modeler® software is recommended for the design of RoomMatch™ arrays in a specific venue. Bose Modeler® software is an acoustic design and analysis program for sound system designers or acoustical consultants. Using a computer-based 3D model of the acoustic space and advanced acoustic ray tracing algorithms, Modeler® can predict the acoustic performance of loudspeaker systems in a specific venue using both direct and reflected sound calculations. Modeler® software has been a leader in sound system performance prediction for more than 25 years and was the first software to provide predictions for Sound Transmission Index (STI), a measure of speech intelligibility and quality.

A new release of Modeler® software, Version 6.7, includes an array design tool optimized to help designers construct progressive directivity arrays using RoomMatch modules. For additional information on using the RoomMatch™ Array Design Tool, please refer to the User Manual for Modeler® Version 6.7 (or higher).

Working Load Limits and Certifications

The structural ratings for all Bose RoomMatch array module loudspeakers and rigging hardware accessories are based on actual tests in which each component is stressed to mechanical failure. A summary of these test results provided in the document, “RoomMatch Test Certification of Compliance,” which is available for download at pro.Bose.com. The results can be expressed in either ultimate break (yield) strength, or as working load limits (WLL) with a specified design safety factor. Bose has chosen to use WLL ratings for all loudspeaker components and rigging hardware. The WLL is defined as the ultimate break strength divided by the safety factor. For example, if a component has ultimate break strength of 10,000 pounds, the WLL rating would be 1,000 pounds with a 10:1 safety factor. This rating provides a margin of safety to accommodate reduced strength from normal wear and dynamic loading. For components used to suspend loudspeakers above audience areas, most local regulatory agencies and building codes specify a required safety factor ranging from 5:1 to 10:1 globally. RoomMatch array module loudspeakers and rigging hardware accessories have WLL ratings based on using a 10:1 safety factor. It is the responsibility of the loudspeaker installer to verify that all applicable local, state, or national safety regulations are fully met.

All structural testing of Bose RoomMatch™ loudspeakers and components is conducted by an independent testing laboratory and certified by independent structural and mechanical Professional Engineers. The working load limit testing follows the guidelines of ANSI E1.8 – 2005, Entertainment Technology Loudspeaker Enclosures Intended for Overhead Suspension – Classification, Manufacture and Structural Testing. For additional information regarding the test procedures and results, please refer to the document, “RoomMatch Test Certification of Compliance,” which is available for download at pro.Bose.com.

Overview of Structural Ratings for Individual Array Elements

There are two independent working load limit (WLL) ratings that must be used together in order to define the overall structural performance of individual elements (loudspeaker modules). The first is the WLL for each individual rigging point, which is based on testing the ultimate break strength of each connection point on the rigging hardware. The second WLL rating is calculated by analyzing the combined forces from all of the rigging points acting on the enclosure as a whole. The smaller of these two ratings must be used to determine the WLL rating for an individual array element used in a specific array configuration.

The following table provides the WLL for each RoomMatch™ module and rigging accessory, based on a per-rigging point calculation. For example, the table lists the WLL for the Small Array Frame as 790 pounds. Using a 2-point suspension of the array, the frame would be rated to support a total column weight of 1580 pounds, with a 10:1 safety factor. Additionally, the RMS215 subwoofer module contains threaded inserts, which are designed for use with custom (contractor supplied) rigging and suspension methods. For the RMS215 subwoofer module, the WLL is listed for both the threaded inserts and the optional RMSFLY side-plate rigging kit.

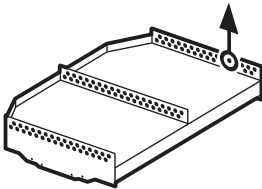
Figure 6. Working Load Limit, Single-Point, 10:1 Design Factor (In Accordance with ANSI E1.8-2005)

WARNING! Never apply a force that exceeds the Working Load Limit of any of the loudspeaker modules, rigging components, or complete loudspeaker arrays as described in this document.

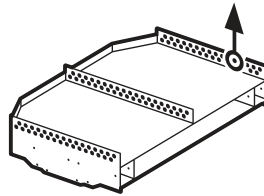
Single Point, 10:1 Working Load Limit

(In Accordance with ANSI E1.8-2005)

RMAFSM – Small Array Frame
WLL = 791 lb. (359 kg.)



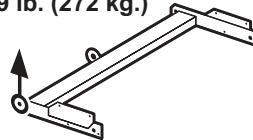
RMAFLG – Large Array Frame
WLL = 1790 lb. (812 kg.)



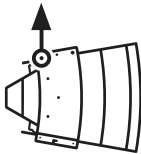
RMXLNG - Long Extender Bar
RMSXRT – Short Extender Bar
WLL = 1790 lb. (812 kg.)



RMPULL – Pull Back Bracket / Mini Frame
WLL = 599 lb. (272 kg.)



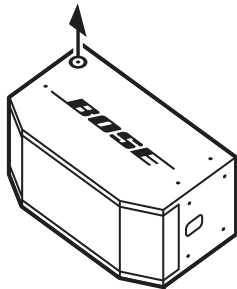
Single Module, RoomMatch™ Loudspeaker
WLL = 1468 lb. (665 kg.)



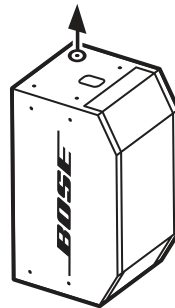
RMSFLY Side-Plate Rigging
WLL = 1468 lb. (665 kg.)



RMS215 Subwoofer
WLL = 510 lb. (231 kg.)



RMS215 Subwoofer
WLL = 510 lb. (231 kg.)



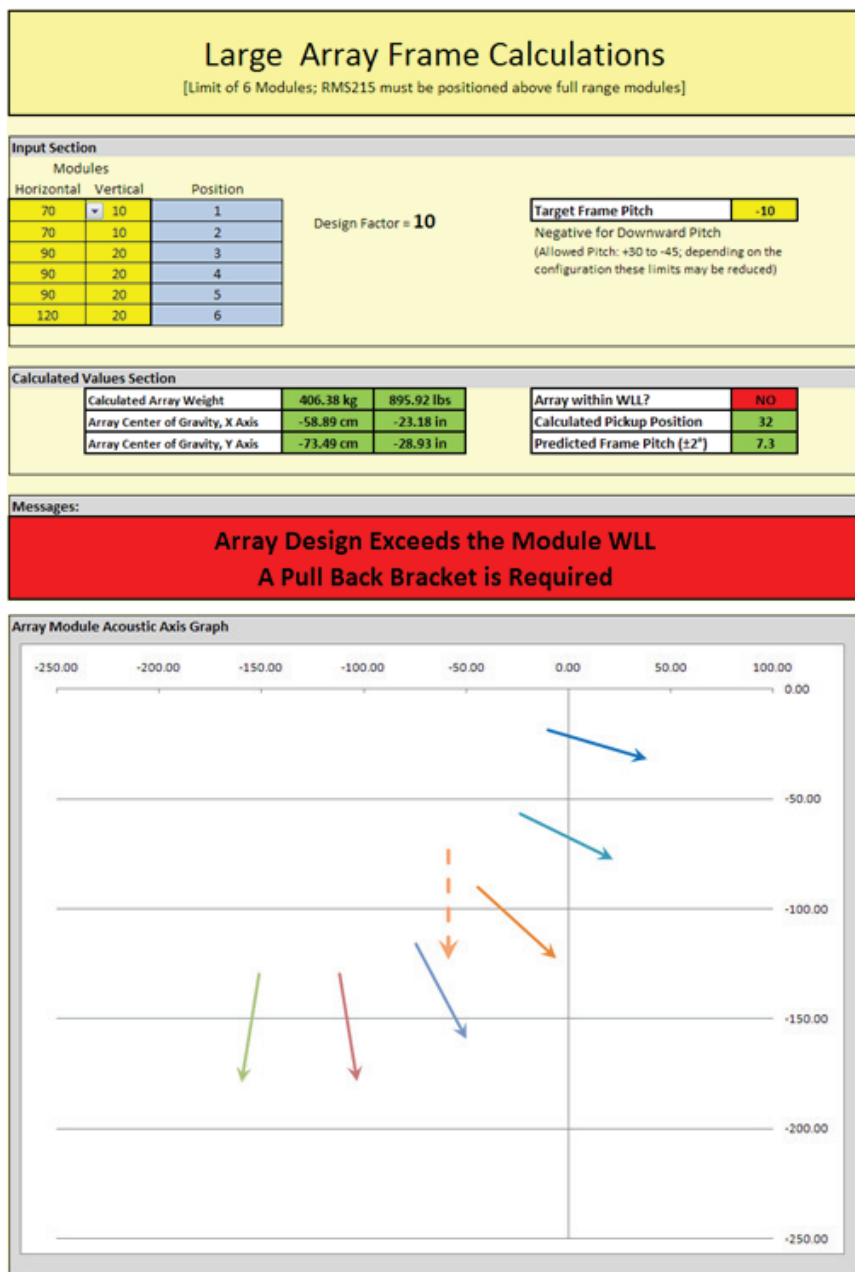
Module System Working Load Limits

The above chart shows the **Per-Point** Working Load Limits for RoomMatch modules and accessories. To calculate the System Working Load Limit for the component, the per-point value is multiplied by the effective number of attachment points that contribute to load bearing. While each module side plate requires 4 physical fastener connections (2 per side), the effective load is supported by only 2 connections per module (1 per side) due to the location of the centers of gravity and fastener locations. Therefore, the System Working Load Limit of the full-range module is rated at: 2 x 1468, or 2936 lbs. This rating is identical for the RMS215 subwoofer with RMSFLY kit. When the RMS215 subwoofer is suspended using the integral threaded inserts, the effective System Working Load Limit is 2 x 510, or 1020 lbs.

Determining Acceptable Load Limits of the Entire Array

The determination of safe Working Load Limits for an entire array of RoomMatch™ modules is a complex process that is recommended only for experienced professional installers and engineers. The first check is to confirm that the total column weight does not exceed the WLL rating for any module or rigging accessory. The second check is to confirm that the rotational, or moment force (torque), does not exceed the WLL rating for any module or rigging accessory. The moment force calculation must be based on the shape of the overall array, which determines the relationship of the center of gravity for the overall array, as compared to the fastener locations each array component. In some array configurations, the moment forces can impart moment loads on a component that exceeds the WLL rating, even though the total weight of the array is less than the WLL rating for any component. For example, the following illustration shows the output of the “RoomMatch Array Frame Suspension Angle Calculator,” which highlights that the WLL of the top module has been exceeded, even though the total column weight of the modules is less than the WLL rating of the top-module enclosure:

Figure 7. RoomMatch™ Array Frame Suspension Angle Calculator WLL Warning Message



As the array pitches downward, the system center of gravity (the dotted arrow pointing downward) moves further back (to the left as shown in the chart). This increases the moment load on the mounting fasteners which pushes them beyond the module WLL prior to reaching the maximum weight limit. This rotational force is more complex to calculate for RoomMatch arrays as compared to calculating similar forces for conventional line array loudspeakers due to the variety of RoomMatch module physical dimensions and included angles.

There are several methods that can determine if the array design is approaching or has exceeded the WLL of any element:

1) Consult a Licensed Professional Engineer

The preferred and recommended method is to consult with a licensed professional engineer, as part of the approval process that is required by most local building codes. The engineer will usually calculate a “free body review” of the array to determine the reaction forces on the mounting fasteners of the array modules, rigging hardware, and building attachment points.

2) Contact Your Local Bose Professional Systems Division Field Engineer

Authorized Bose Professional Systems Division AV Integrators and Design Consultants may contact their local Bose Field Engineer or Technical Support Specialist. These professionals may use the “RoomMatch Array Frame Suspension Angle Calculator” software, which can help predict the shackle pickup points that are required to achieve specific array pitch angles. Additionally, the software will indicate when array Working Load Limits are nearing or exceeding safe rated values, or when an additional third suspension point using the RMPULL bracket is required.

3) Use the Simplified Array Load Limit Guidelines

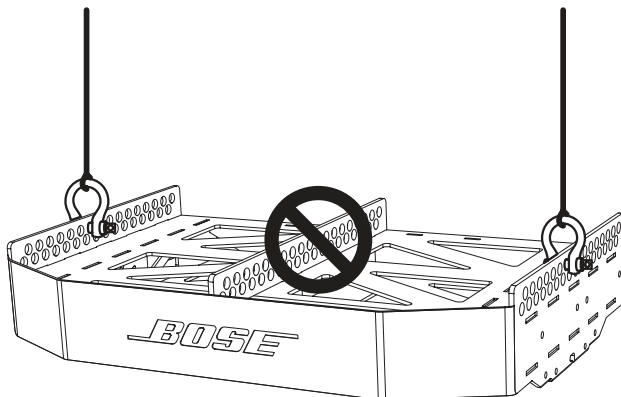
For smaller, less complex array configurations, a table of Simplified Array Load Limit Guidelines is presented in this manual that defines the frame size, number of array modules, number of subwoofer modules, total included vertical angle of array modules, and the maximum array pitch angles, that will allow safe Working Load Limits. See the data tables on pages 12-14 of this document.

General Guidelines for RoomMatch Array Rigging

The following general guidelines apply to all configurations of RoomMatch arrays (unless otherwise specifically approved by a licensed mechanical or structural professional engineer):

- 1) Small Array Frame may contain a maximum of 4 modules (full-range or subwoofer).
- 2) Large Array Frame may contain a maximum of 8 modules (full-range or subwoofer).
- 3) Subwoofer modules must always be located in the top positions (closest to frames).
- 4) The total included vertical angle of all modules should not exceed 120 degrees.
- 5) The mounting holes on the rails of the grids (\varnothing 0.81”) have been sized for a nominal 5/8” shackle. A 19-mm shackle may also be used. Use of smaller sized shackles is not recommended.
- 6) Extender Bars must be used with the Large Array Frame (will not fit the Small Array Frame).
- 7) Extender Bars (Long or Short) may support a maximum of 2 subwoofer modules.
- 8) Each of the Extender Bars has an IN and an OUT position. Two fasteners are used to connect each extension to the grid. The extensions should never be used with fewer than 2 fasteners per side (total of 4 fasteners).
- 9) Do not suspend modules directly from side-plate hardware using wire rope (without array frames).
- 10) Use only the outer left and right rails in the Array Frames for permanent attachment to building structures.
- 11) Do not use the center rail of array frames as the only permanent attachment point. The center rail is designed only for temporary support for elevating arrays using chain hoist or other lifting devices.

Figure 8. Permanent Attachment Points to Building Structure for Array Frames



The Left and Right side rails of the array frames are recommended as the only permanent attachment points as these rails provide the most direct load path from the frame to the module side-plate rigging system. Additionally, the published values for Working Load Limits were based on certification testing using the Left and Right rails connected to the module side-plate rigging.

Simplified Load Limit and Pitch Angle Tables

The following charts list configurations of modules that have been calculated to not exceed the working load limits of any module or any array frame component, based on the parameters specified. The charts also provide suggested pickup points in the array frames for various desired array pitch angles, along with the maximum downward pitch (negative number) for the frame and module combinations. For module configurations not listed below, please contact your local Bose Field Engineer or Technical Support Specialist.

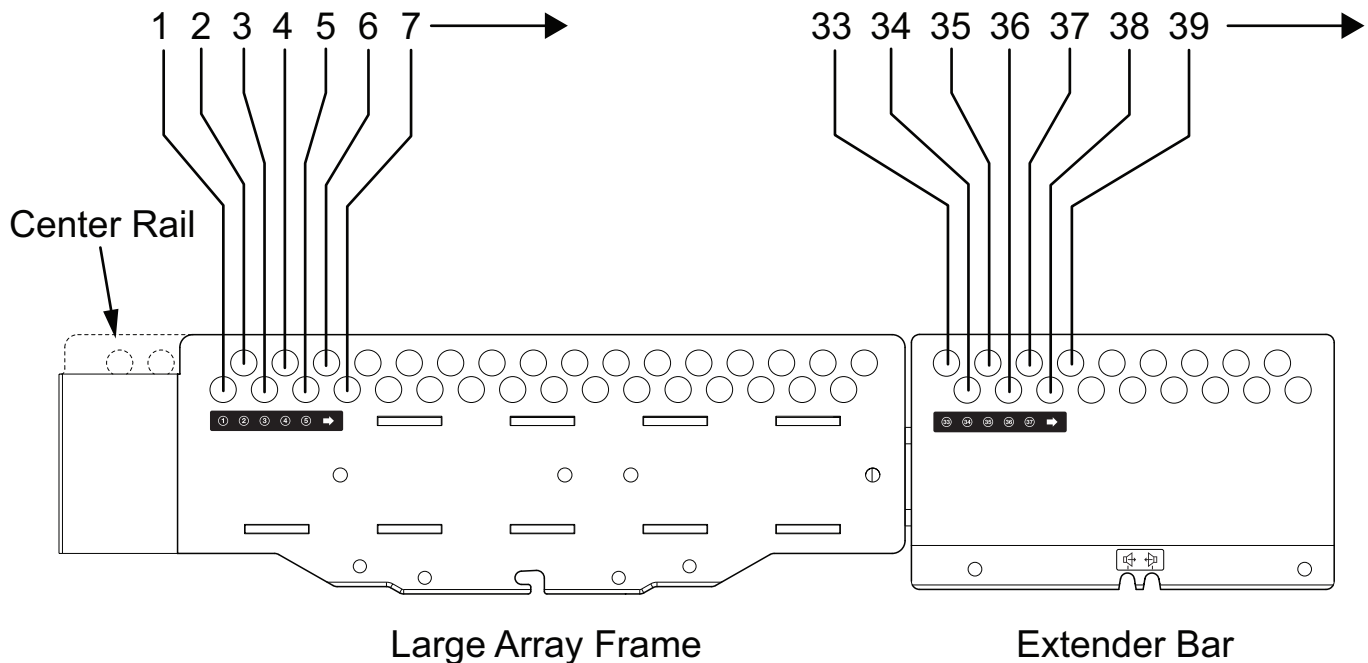
How to Read the Charts: The charts below are grouped by the number of modules in each array. Each table contains information for a specific combination of modules defined by vertical coverage and listed in the first column of each table. For example, the first table below lists a 2-module with sub configuration with a 40° total vertical angle, consisting of a RMS215 subwoofer module in the first position, an RMxx20 module (module with any horizontal and 20° vertical coverage), and another RMxx20 module in the third position. The second column lists the desired, or target, pitch of the entire array, as referenced from the top surface plane of the array frame, with angles pitched down from horizontal listed as negative numbers (see Simplified Chart Notes on page 14). For each listed “Desired Pitch” angle, read across the chart to determine the calculated pickup points in the left and right rails of the array frame. The right-most column lists the calculated pitch angle for the listed pickup points. When the maximum pitch angle has been reached for the specified array configuration, the table will list “n/a” for the pickup point and predicted pitch values.

Prediction Accuracy: To confirm the accuracy of the predicted pitch angles, we tested both the Small Array Frame and Large Array Frame to compare actual constructed array pitch angles versus the predicted values. The testing revealed an accuracy of 96% using a tolerance of 2.0 degrees from predicted value. Many factors contribute to the variation including manufacturing tolerance. Therefore, we always recommend confirming the array pitch during installation with an inclinometer, and making adjustments in the predicted pickup point as required.

Array Frame Pickup Point Reference: The pickup point for array frames is always referenced to the shackle holes for the left and right rails. The center rail of the array frames is intended only for temporary attachment and has a different hole pattern as compared to the left and right rails. The shackle holes on each rail have a top and bottom position. However, the pickup point positions are numbered sequentially from 1 to 32 for the Large Frame and 1 to 33 for the Small Frame, without reference to the top or bottom positions. Both left and right rails have a label that identifies the starting point of the pickup position numbering and direction of increment. The label does not contain numbering for every single position. Note: Do not use pickup point reference numbering for center rail!

Extender Bar Pickup Point Reference: The pickup point reference for the Extender Bars starts with 1 number greater than the last number of the Large Array Frame. Thus, the first pickup point reference number for the Extender Bars is 33. See Figure 9.

Figure 9. Array Frame and Extender Bar Pickup Point Numbering Reference



Small Array Frame: 2 Modules with Subwoofer

2-Module with Sub (40° Total V)				2-Module with Sub (60° Total V)				2-Module with Sub (80° Total V)			
Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch
RMS215	10	9	11.0	RMS215	10	9	11.4	RMS215	10	12	10.0
RMxx20	5	12	6.4	RMxx20	5	13	5.2	RMxx40	5	15	-5.3
RMxx20	0	16	0.2	RMxx40	0	16	0.5	RMxx40	0	18	0.4
	-5	19	-4.5		-5	19	-4.2		-5	21	-4.5
	-10	22	-9.1		-10	22	-8.8		-10	24	-9.3
	-15	25	-13.7		-15	26	-14.9		-15	27	-14.0
	-20	29	-19.4		-20	29	-19.2		-20	31	-19.9
	-25	33	-24.8		-25	33	-24.6		-25	33	-22.8

Small Array Frame: 3 Modules

3-Module (70° Total V)				3-Module (80° Total V)				3-Module (90° Total V)			
Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch
RMxx10	10	15	10.1	RMxx20	10	18	10.7	RMxx10	10	15	10.5
RMxx20	5	18	5.1	RMxx20	5	21	5.5	RMxx20	5	18	5.5
RMxx40	0	21	0.1	RMxx40	0	24	0.2	RMxx60	0	21	0.4
	-5	24	-4.9		-5	26	-3.3		-5	24	-4.7
	-10	27	-9.9		-10	29	-8.5		-10	27	-9.7
	-15	30	-14.7		-15	33	-15.2		-15	30	-14.5
	-20	33	-19.3		-20	n/a	n/a		-20	33	-19.2
	-25	n/a	n/a		-25	n/a	n/a		-25	n/a	n/a

Small Array Frame: 3 Modules with Subwoofer

3-Module with Sub (70° Total V)				3-Module with Sub (80° Total V)				3-Module with Sub (90° Total V)			
Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch
RMS215	10	10	10.1	RMS215	10	12	10.7	RMS215	10	10	10.3
RMxx10	5	14	5.4	RMxx20	5	16	5.9	RMxx10	5	14	5.6
RMxx20	0	18	0.6	RMxx20	0	20	1.0	RMxx20	0	18	0.8
RMxx40	-5	22	-4.2	RMxx40	-5	24	-3.9	RMxx60	-5	22	-4.0
	-10	26	-8.9		-10	29	-9.9		-10	27	-9.9
	-15	31	-14.6		-15	33	-14.6		-15	31	-14.5
	-20	33	-16.8		-20	n/a	n/a		-20	33	-16.7
	-25	n/a	n/a		-25	n/a	n/a		-25	n/a	n/a

Small Array Frame: 4 Modules

4-Module (60° Total V)				4-Module (80° Total V)				4-Module (90° Total V)			
Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch	Array Modules	Desired Pitch	Pickup Point	Predicted Pitch
RMxx10	10	16	10.9	RMxx10	10	16	11.2	RMxx10	10	19	10.6
RMxx10	5	20	6.0	RMxx10	5	20	6.2	RMxx20	5	23	5.4
RMxx20	0	24	1.0	RMxx20	0	24	1.2	RMxx20	0	27	0.2
RMxx20	-5	28	-4.0	RMxx40	-5	28	-3.9	RMxx40	-5	30	-3.7
	-10	33	-10.2		-10	33	-10.1		-10	33	-7.6
	-15	n/a	n/a		-15	n/a	n/a		-15	n/a	n/a
	-20	n/a	n/a		-20	n/a	n/a		-20	n/a	n/a
	-25	n/a	n/a		-25	n/a	n/a		-25	n/a	n/a

Large Array Frame: 5 Modules

5-Module (60° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	14	11.0
RMxx05	5	20	5.1
RMxx10	0	25	0.2
RMxx20	-5	30	-4.8
RMxx20	-10	32	-6.7
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

5-Module (70° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx10	10	20	10.3
RMxx10	5	25	5.3
RMxx10	0	30	0.2
RMxx20	-5	32	-1.9
RMxx20	-10	n/a	n/a
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

5-Module (75° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	18	10.9
RMxx10	5	23	5.9
RMxx20	0	28	0.8
RMxx20	-5	32	-3.3
RMxx20	-10	n/a	n/a
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

5-Module (80° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	15	10.1
RMxx05	5	20	5.2
RMxx10	0	25	0.3
RMxx20	-5	30	-4.7
RMxx40	-10	32	-6.6
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

5-Module (85° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.1
RMxx10	5	22	5.1
RMxx10	0	27	0.1
RMxx20	-5	32	-4.9
RMxx40	-10	n/a	n/a
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

5-Module (90° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx10	10	20	10.4
RMxx10	5	25	5.4
RMxx10	0	30	0.3
RMxx20	-5	32	-1.8
RMxx40	-10	n/a	n/a
	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

Large Array Frame: 6 Modules

6-Module (60° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.1
RMxx05	5	23	5.3
RMxx10	0	29	0.3
RMxx10	-5	32	-2.2
RMxx10	-10	n/a	n/a
RMxx20	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

6-Module (70° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.6
RMxx05	5	23	5.7
RMxx10	0	29	0.7
RMxx10	-5	32	-1.8
RMxx20	-10	n/a	n/a
RMxx20	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

6-Module (75° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	20	10.4
RMxx10	5	26	5.5
RMxx10	0	32	0.4
RMxx10	-5	n/a	n/a
RMxx20	-10	n/a	n/a
RMxx20	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

6-Module (80° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	19	10.3
RMxx05	5	25	5.3
RMxx10	0	31	0.2
RMxx20	-5	32	-0.7
RMxx20	-10	n/a	n/a
RMxx20	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

6-Module (85° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	16	10.0
RMxx05	5	22	5.2
RMxx05	0	28	0.3
RMxx10	-5	32	-3.0
RMxx20	-10	n/a	n/a
RMxx40	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

6-Module (90° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.6
RMxx05	5	23	5.7
RMxx10	0	29	0.7
RMxx10	-5	32	-1.8
RMxx20	-10	n/a	n/a
RMxx40	-15	n/a	n/a
	-20	n/a	n/a
	-25	n/a	n/a

Large Array Frame with Short Extender Bars (In Position): 6 Modules

6-Module (60° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.3
RMxx05	5	23	5.0
RMxx10	0	28	0.6
RMxx10	-5	32	-2.9
RMxx10	-10	37	-9.9
RMxx20	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

6-Module (70° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.7
RMxx05	5	23	5.5
RMxx10	0	29	0.1
RMxx10	-5	32	-2.6
RMxx20	-10	37	-9.6
RMxx20	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

6-Module (75° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	20	10.4
RMxx10	5	26	5.0
RMxx10	0	31	0.5
RMxx10	-5	34	-4.9
RMxx20	-10	39	-9.4
RMxx20	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

6-Module (80° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	19	10.3
RMxx05	5	24	5.8
RMxx10	0	30	0.4
RMxx20	-5	32	-1.5
RMxx20	-10	38	-9.5
RMxx20	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

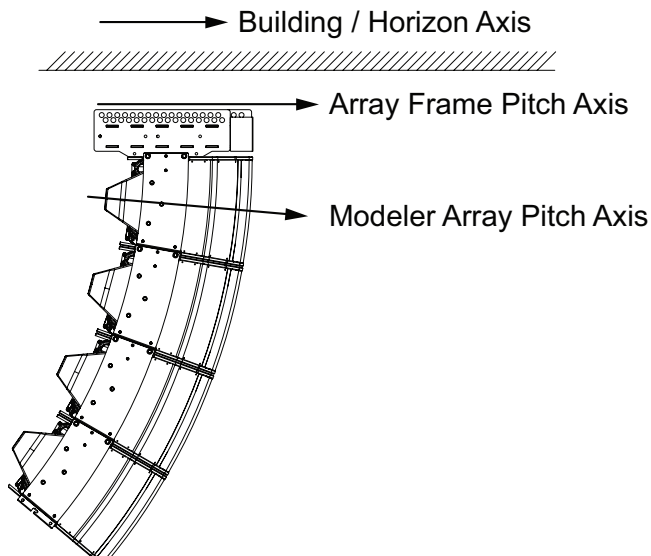
6-Module (85° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	16	10.2
RMxx05	5	22	5.0
RMxx05	0	27	0.6
RMxx10	-5	32	-3.8
RMxx20	-10	36	-9.8
RMxx40	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

6-Module (90° Total V)			
Array	Desired	Pickup	Predicted
Modules	Pitch	Point	Pitch
RMxx05	10	17	10.8
RMxx05	5	23	5.5
RMxx10	0	29	0.2
RMxx10	-5	32	-2.5
RMxx20	-10	37	-9.6
RMxx40	-15	n/a*	n/a*
	-20	n/a*	n/a*
	-25	n/a*	n/a*

Simplified Chart Notes:

- 1) Modeler® software calculates “array pitch” referenced to the acoustic centerline axis of the module in the first (top most) array position. To convert the Modeler® array pitch number to the “array frame” pitch used in the above tables, take the Modeler® array pitch number then add to this number one-half of the nominal coverage angle number of the module in the first array position. See Figure 10.
- 2) n/a denotes that array frame pickup point is at maximum; additional pitch requires pull-back bracket with third attachment point.
- 3) n/a* denotes that WLL limits require use of pull-back bracket to reduce moment force loads; desired pitch may be possible using additional pickup points of Extender Bars; please consult your local Bose Professional Systems Division Field Engineer or Technical Support Specialist for additional information.

Figure 10. Modeler® Array Pitch versus Array Frame Pitch



Application of the RMPULL Bracket

There are three primary applications of the RMPULL bracket for use with RoomMatch™ arrays:

- 1) For use as “mini frame” to suspend 1 or 2 full-range modules
- 2) For use with either Small Array Frame or Large Array Frame for pitch angle adjustment
- 3) For use with Large Array Frame to reduce module moment-force loads

The RMPULL bracket may be used as a “mini frame” to suspend 1 or 2 full-range modules, as suspending the modules directly from the integrated side-plate rigging hardware is not recommended. When used in this application, the range of suspension angles is limited using 2-point attachment to the building structure. See Figure 11 below. For greater adjustments in suspension angles, an additional RMPULL bracket may be attached to the bottom module and used as a third-attachment point to the building structure, to allow angle adjustment. See Figure 12 below. The RMPULL bracket may NOT be used to suspend subwoofer modules.

Figure 11. RMPULL bracket for 2-module Array

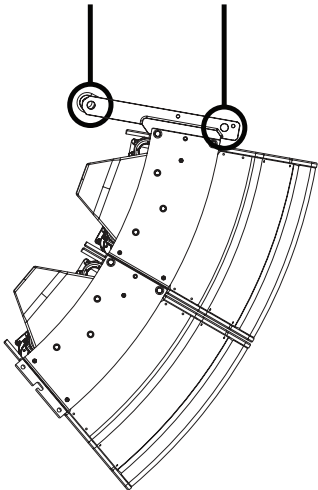
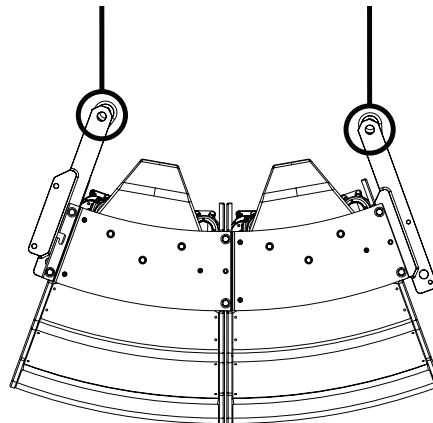
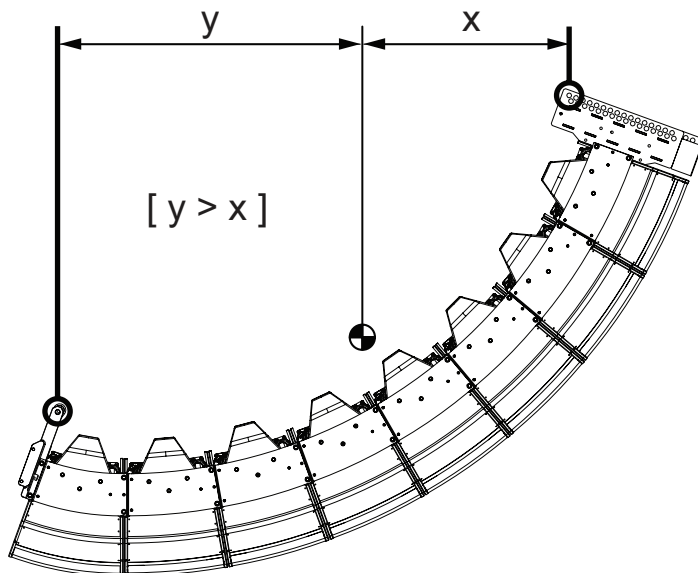


Figure 12. RMPULL brackets top and bottom for 2-module Array



Most commonly, the RMPULL bracket is used as a third-attachment point to the building structure, to allow greater pitch angles, or more precise resolution of the array. The pitch angle adjustment resolution of the Array Frames using 2-point gravity suspension varies with module configuration. Additionally, the accuracy of the pitch angle prediction using the “RoomMatch Array Frame Suspension Angle Calculator” software is plus or minus 2 degrees. Therefore, when precise array pitch angles are required (typically for long throw distances), the use of the RMPULL bracket with a third attachment point is recommended. Attachment of wire rope (or other materials) directly to the module integrated side-plates for this purpose is not recommended. When using the RMPULL bracket, the pickup point on the Array Frame should be positioned as close to the array center of gravity (COG) as possible. This will reduce the load force on the RMPULL bracket. Additionally, the distance between the RMPULL bracket attachment and array center of gravity (distance “Y” in Figure 13) must be greater than the distance from the frame attachment and center of gravity (distance “X” in Figure 13).

Figure 13. Array Frame, Pullback Bracket, and Array Center of Gravity



An additional application of the RMPULL is for large arrays of 6 to 8 modules that require reduction of moment force loads from 2-point suspension with extreme angles. This condition may be predicted by consultation with a Professional Engineer, or Bose Professional Systems Division Field Engineer, using an advanced version of the "RoomMatch Array Frame Suspension Angle Calculator" software. Use of the RMPULL bracket for this application should only be attempted after consultation with one of the listed sources.

Shock Loading

The Working Load Limit ratings are for static (non-moving) load conditions. Movement of the array, such as when starting or stopping chain hoist motors, can significantly amplify the load forces applied to the array and exceed the WLL ratings developed for static loads. Therefore, installers should use extreme caution when starting or stopping chain hoist motors with arrays, or any other conditions that result in the motion of the arrays during the installation process.

Horizontal Arrays Not Recommended

The current version of RoomMatch array modules have not been load rated for horizontal suspension by the integrated rigging system. Therefore, horizontal array configurations, in which the modules are connected by the integrated side-plates and suspended with the plates at the "top" and "bottom" of the array, rather than left and right sides of the array, are not permitted.

Ground Stack Arrays

Optional Ground Stack Kit accessories are available to accommodate ground stack arrays of up to 3 RoomMatch modules for occasional movement to different locations, such as temporary side-stage fills for Performing Arts Centers that require differing seating configurations. RoomMatch modules and Ground Stack Kit are not recommended for Tour Sound applications that require daily setup and transportation. For additional information regarding ground stack accessories and array configurations, please refer to the document "RoomMatch Ground Stack Kit Accessories Installation and Safety Guidelines," which is available for download at pro.Bose.com.

RoomMatch Array Frames are not approved or recommended for ground stack applications.

RMGSSB Ground Stack Subwoofer Brackets should always be used to secure subwoofer modules in ground-stack applications of more than 1 unit in height.

Field Installation Rigging of Arrays

Prior to installation at the job site, several operations and checks are recommended to be completed at the installer's shop facilities, to avoid potential problems or delays, and reduce downtime for the installation venue:

- 1) Unpack all array module loudspeakers and rigging accessories
- 2) Confirm that all models and part numbers match those specified in the design
- 3) Check the physical condition of all products to confirm that none have sustained shipping damage
- 4) Conduct continuity test of all loudspeaker inputs
- 5) Install any required module accessories, such as the RMSHAD gain-shading kit
- 6) Using recommended DSP and amplifier power, test each bandpass section for each module and confirm performance

Before You Begin – Recommended Tools

- (2) 13 mm sockets and socket wrenches (for RMBRKT surface-mount kit accessory fasteners)
- (2) 15 mm sockets and socket wrenches (for module to module bolts: M10 x 30 mm)
- (2) 17 mm sockets and socket wrenches (for array frame extender bar bolts: M10 x 120 mm)
- (2) 17 mm combination wrenches (array frame extender bar nuts)
- (2) 5/16" Aligning Punch (optional; to aid bolt alignment)

Module Installation in Arrays

Note: Prior installation of field wiring and a safety-rated suspension system, e.g. chain-hoist motors or wire-rope slings, is assumed. Motors may be used as a permanent suspension method or to temporarily elevate an array to final position for attachment to conventional rigging hardware.

Note: All lifting operations require two individuals, one for each side of the loudspeaker.

Each array module and rigging accessory is shipped with a printed "Safety and Installation Guidelines" document. Please refer to these documents for detailed assembly instructions for array modules and rigging accessories. These documents are also available for download from the website pro.Bose.com.

Integrating Subwoofers with Arrays

The RoomMatch™ subwoofer modules are designed with the same width as the full-range modules (with the optional RMSFLY kit installed) to allow use with most RoomMatch rigging accessories. RoomMatch subwoofer modules may be combined with full-range modules in the same array, or used exclusively in subwoofer-only bass arrays. The choice of “flying” or floor mounting subwoofers involves complex analysis of the venue physical dimensions and mounting limitations, room acoustics, aesthetic requirements, and desired uniformity of coverage in the listening areas. While the analysis of all of these factors is beyond the scope of this document, your local Bose Field Engineer or Technical Support professional can provide assistance in this area. Once the decision to array subwoofers is confirmed, the following are typical subwoofer array configurations using RoomMatch rigging accessories:

Small Array Frame with Subwoofer Modules

The Small Array Frame (RMAFSM) allows up to 4 RoomMatch RMS215 subwoofer modules (with RMSFLY kits installed) to be configured as a vertical column array. The vertical array dimensions provide increased directional control of low-frequencies in the vertical plane. Subwoofer arrays with vertical column configurations are recommended to be installed with 0 degree pitch, to ensure equal distribution of load forces in the rigging hardware.

Large Array Frame with Subwoofer Modules

The Large Array Frame (RMAFLG) allows up to 8 RoomMatch RMS215 subwoofer modules (with RMSFLY kits installed) to be configured as a vertical column array. The vertical array dimensions provide increased directional control of low-frequencies in the vertical plane. Subwoofer arrays with vertical column configurations are recommended to be installed with 0 degree pitch, to ensure equal distribution of load forces in the rigging hardware.

Large Array Frame plus Extender Bars with Subwoofer Modules

The Large Array Frame with Extender Bars (RMXSRT or RMXLNG) is typically used to integrate subwoofer modules behind other modules in the same array. The Extender Bars can accommodate up to 2 RMS215 subwoofer modules mounted in the rear position. This allows the Large Array Frame with Extender Bars to be configured as a “2 x 2” subwoofer array, with or without additional full-range modules to be integrated in the same array. The largest RoomMatch array configuration using standard rigging accessories uses this configuration with the “2 x 2” subwoofer array, plus an additional 6 full-range modules. Note: This configuration requires use of the RMPULL bracket attached to the bottom full-range module to provide a third structural attachment point for the array (in addition to the attachment points of the left and right rails). For DSP settings and directivity information for subwoofer arrays, please refer to the document, “RoomMatch Array Rigging Frames and Accessories Installation and Safety Guidelines.”

Using Subwoofer Threaded Inserts for Custom Rigging

The RoomMatch RMS215 subwoofer module is equipped with M10-size threaded inserts to allow suspension using graded eyebolts or custom-designed rigging solutions. Please refer to the “RoomMatch Subwoofer Module Installation and Safety Guidelines” document for additional information.

RMPINS Quick-Connect Pins

An optional accessory kit (RMPINS) is available with quick-connect pins designed to replace the standard threaded fasteners used for module-to-module connections in RoomMatch arrays. The quick connect pins do not change the WLL ratings of any recommended array configuration and can be used with either the full-range or subwoofer modules. Each kit contains 4 quick-connect pins, which are required for each module in the array.

RMSHAD Gain Shading Kit

An optional gain shading kit (RMSHAD) is available for RoomMatch™ modules to attenuate the lower-3 compression drivers relative to the upper-3 drivers. This option may provide more uniform coverage in array configurations with large changes in directivity index from module to module. The need for the Gain Shading Kit is best determined by using Bose Modeler sound system design software and reviewing the room coverage predictions. For installation instructions, please refer to the document, “RoomMatch RMSHAD Module Gain Shading Kit Accessory Instruction Sheet.”

Digital signal processing (DSP) equipment is required for infrasonic protection, crossover, equalization, and protection limiting functions for all RoomMatch array modules. The Bose PowerMatch™ PM8500 professional amplifier and Bose ControlSpace® ESP (both sold separately) contain presets for all RoomMatch modules. When using other types of signal processing equipment, the following crossover filters are recommended:

Full-Range Module Applications (for use without subwoofers)

Driver Elements	High-Pass Filter			Low-Pass Filter		
	Type	Slope	Frequency	Type	Slope	Frequency
Module LF	Butterworth	24 dB/octave	50 Hz	Butterworth	24 dB/octave	510 Hz
Module HF	Butterworth	24 dB/octave	580 Hz	none	none	none

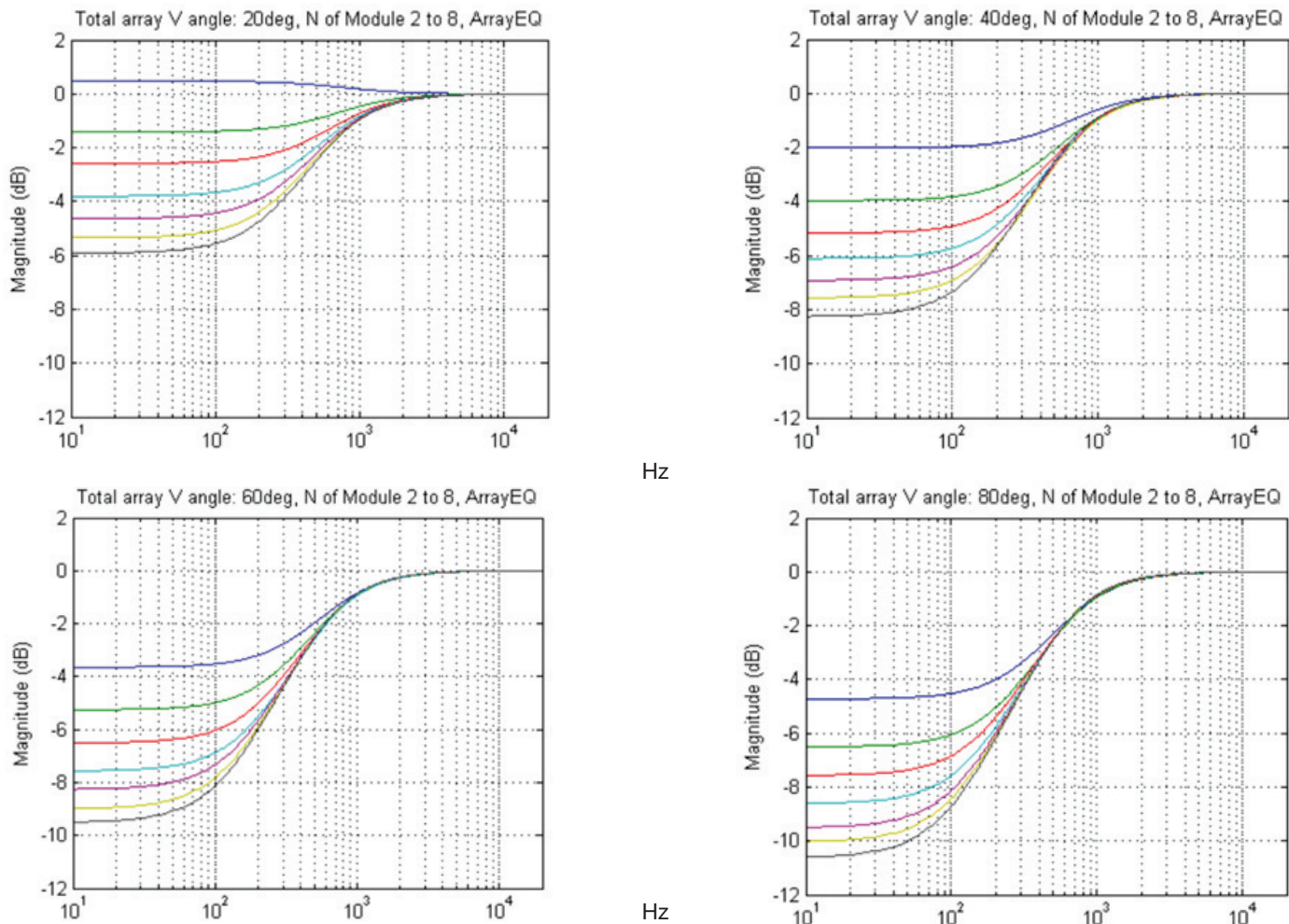
Full-Range Module with Subwoofer Applications

Driver Elements	High-Pass Filter			Low-Pass Filter		
	Type	Slope	Frequency	Type	Slope	Frequency
Subwoofer RMS215	Butterworth	12 dB/octave	40 Hz	Butterworth	24 dB/octave	80 Hz
Module LF	Butterworth	24 dB/octave	80 Hz	Butterworth	24 dB/octave	510 Hz
Module HF	Butterworth	24 dB/octave	580 Hz	none	none	none

Array Compensation EQ

The RoomMatch module EQ presets in ControlSpace ESP and PowerMatch are based on the single module frequency response. For multiple-module arrays, an additional EQ stage is required to compensate for the mutual acoustic coupling of the woofers. A special DSP filter network has been developed for RoomMatch modules to provide consistent tonal balance independent of the number of full-range modules in the array. This filter allows the user to set the number of full-range modules and the total vertical angle of the array and generate the following electrical responses:

Figure 14. RoomMatch™ Array EQ Electrical Response Graphs



Examples of Typical RoomMatch™ Array Configurations

Single Module Surface Mount

RMBRKT
Single Full-Range Module



2-Module Array

RMPULL
2 x Full-Range Modules



2-Module with Sub Array

RMAFSM
RMSFLY
1 x Subwoofer Module
2 x Full-Range Modules



4-Module Array

RMAFSM
4 x Full-Range Modules



4-Module with Cardioid-Sub Array

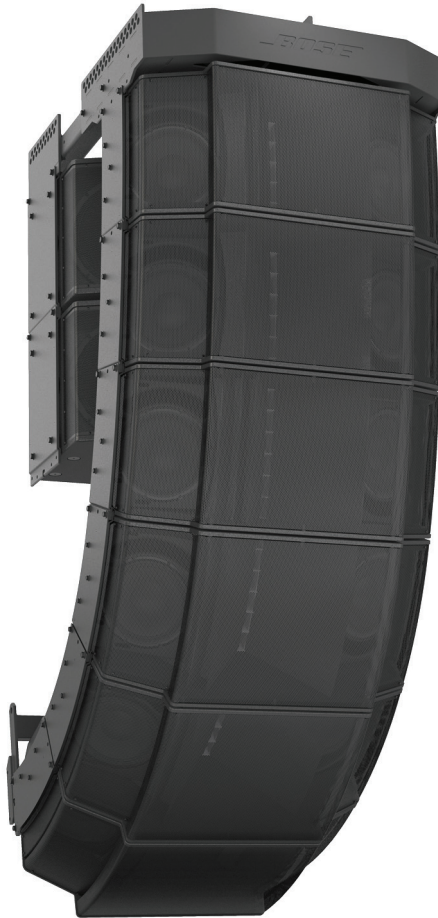
RMAFLG
RMSRT
2 x Subwoofer Modules
2 x RMSFLY
4 x Full-Range Modules

6-Module with 2-Rear-Sub Array

RMAFLG
RMXLNG
2 x Subwoofer Modules
2 x RMSFLY
6 x Full-Range Modules
RMPULL

8-Module Array

RMAFLG
8 x Full-Range Modules



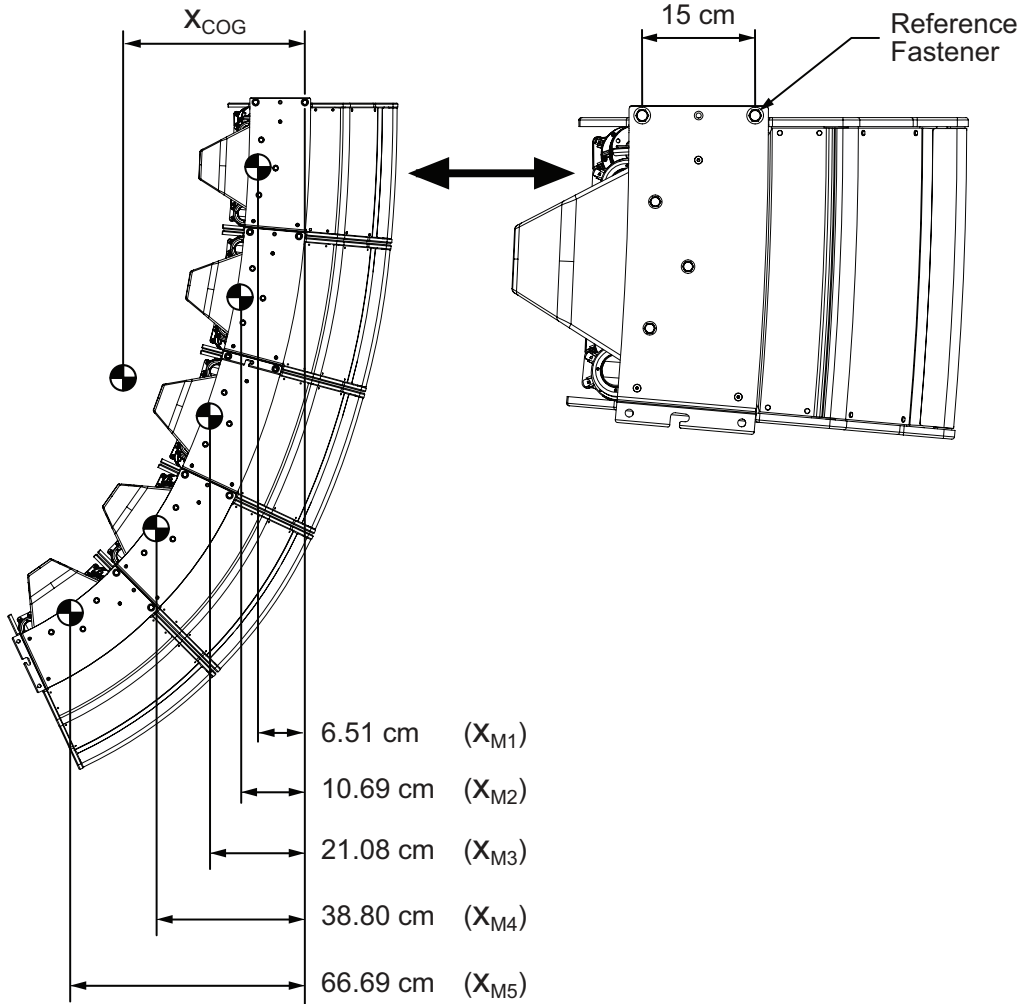
Example Free Body Diagram Determination of WLL:

The following example shows a free body diagram determination of the working loads for a RoomMatch™ array of RM7005, RM7010, RM9010, RM9020, and RM12020 modules with a 0-degree frame pitch.

Step 1. Determine the array center of gravity in the X-axis using the equation:

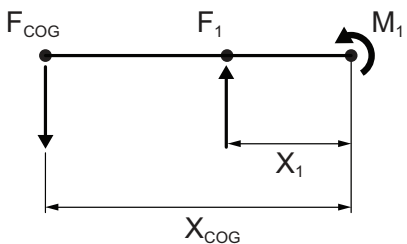
$$X_{COG} = \frac{\sum X_M * W_M}{W_A}$$

Where: X_{COG} = X-axis distance of array COG from reference fastener
 X_{Mn} = X-axis distance from reference to module COG for module n (n = 1 to 8)
 W_M = Weight of module (example: 56.7 kg)
 W_A = Weight of total array (example: 283.5 kg)



$$X_{COG} = \frac{(6.51)*(56.7) + (10.69)*(56.7) + (21.08)*(56.7) + (38.8)*(56.7) + (66.69)*(56.7)}{(283.5)} = 28.75 \text{ cm}$$

Step 2. Free Body Review. Assuming the front fastener is a pivot point and the rear fastener is bearing the entire load (a conservative approach), the following free body diagram can be developed for one side of the top module:



Where: M_1 = Moment (rotational) force about front module fastener
 F_1 = Force applied on rear-module fastener
 F_{COG} = Force applied by total array per side (1/2 of total weight)
 X_1 = X-axis distance from front to rear fastener (15 cm)
 X_{COG} = X-axis distance from array center of gravity to front fastener

The following general equation can be used to calculate the moment (rotational) force about point M (front fastener):

$$\Sigma M_1 = (F_1 * X_1) - (F_{COG} * X_{COG})$$

To calculate the load applied to the rear fastener of the top module side in the above diagram, the above equation must be solved for the F1 value. For the load to be fully supported by the rear fastener, the moment force about M1 will be 0, with the force of F1 being equal but opposite the FCOG force. Thus, the equation becomes:

$$0 = (F_1 * X_1) - (F_{COG} * X_{COG}) \text{ where } F_{COG} = (1/2) * W_A \text{ (as each side supports half the total)}$$

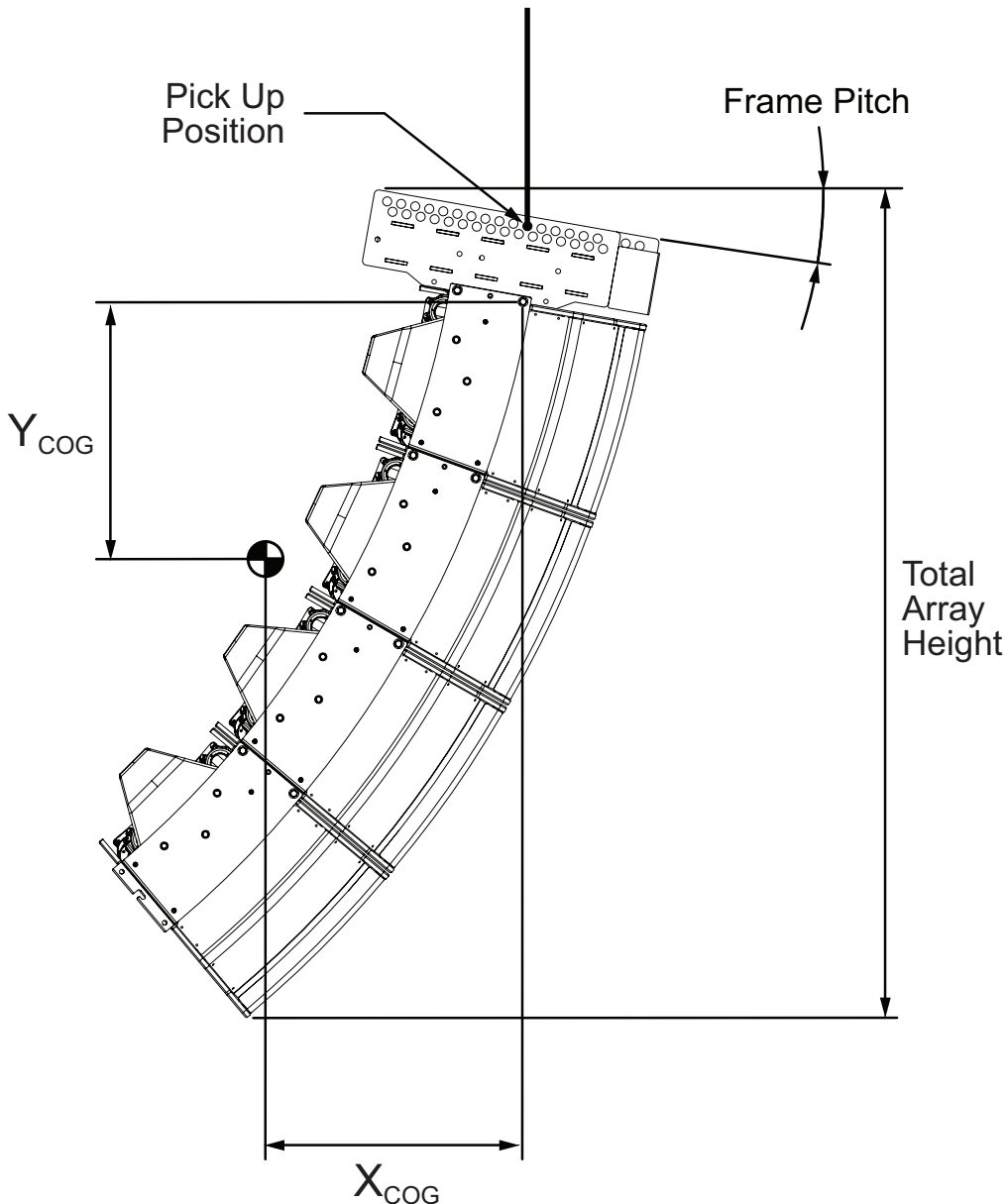
$$0 = F_1 * 15 - (283.5 / 2) * (28.75)$$

Solving for F₁: $F_1 = ((283.5 / 2) * (28.75)) / 15$
 $= 271.68 \text{ kg}$

Step 3. Compare F_M to WLL. Compare the results for F_M to the per point WLL given for the array element. The calculated value of 271.68 kg is less than the per-point WLL of 412 kg. Therefore, the array design is within load limits.

The above example illustrates a very simple case. Additional elements, combinations of elements, and positive or negative pitch of the array frame will significantly complicate the calculations. It is recommended that the designer choosing to use this method review the results with a licensed professional engineer.

Center of Gravity Dimension Frame of Reference



Fastener technical information:

The following is a list of the fastener sizes that are included with the different RoomMatch™ accessory rigging hardware:

RoomMatch Fastener Size Chart					
Part Name	Metric Size	Thread Pitch	Length (mm)	Class Marking	Quantity Included
Full-range module side plates	M10	1.5	30	10.9	4
Subwoofer RMSFLY side-plate kit	M10	1.5	40	10.9	4
RMAFSM and RMAFLG Array Frames	none	none	none	none	none
RMXSRT and RMXLNG Extender Bars	M10	1.5	120	10.9	4
RMBRKT surface-mount bracket	M10	1.5	40	10.9	4
RMPULL bracket	M10	1.5	30	10.9	4

Class 10.9 refers to the load rating of the fastener. The “10.9” is always marked on the head of the fastener, as illustrated in the figure below. Unmarked fasteners or fasteners with a lower class than those listed in the chart above should never be used.



Websites:

- www.pro.bose.com
- www.adapttechgroup.com
- www.rigging.net
- www.thecrosbygroup.com
- www.cmworks.com
- www.synaudcon.com
- www.riggingwarehouse.com

Description

- Bose Professional Systems Division
- Adaptive Technologies Group (ATM Fly-Ware)
- Independent website listing graded fasteners
- Supplier of accessories used in the lifting industry
- Supplier of chain hoists and accessories
- Seminars for sound system design and acoustics
- Supplier of shackles and other rigging hardware

Books:

- Sound System Engineering, Third Edition by Don Davis and Eugene Patronis, published by Focal Press (September, 2006), ISBN-13: 978-0240808307
- Entertainment Rigging by Harry Donovan, published by SAP (1999). May be purchased direct from www.riggingbooksandprograms.com
- Marks' Standard Handbook for Mechanical Engineers, 11th Edition by Avallone, Baumeister, and Sadegh, published by McGraw-Hill Professional (November 16, 2006), ISBN-13: 978-0071428675

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AM346852 Rev. 02